
THE GOULANDRIS NATURAL HISTORY MUSEUM
GREEK BIOTOPE / WETLAND CENTRE

# Evaluation of functions and values of Attica Wetlands in Greece

**Thematic Centre: Drought, Water and Coasts.**

**Pilot Study 4 "Effects of climate change on wetland ecosystems in Attica Region, Greece**

**March 2014**



The present work is part of the Greek Pilot Study 4 "Effects of climate change on wetland ecosystems of Attica, Greece" which was carried out under the Thematic Centre "Drought, Water and Coasts" of ORIENTGATE project.

The OrientGate project is co-financed through the South East Europe Transnational Cooperation Programme, which aims to develop transnational partnerships on matters of strategic importance in order to improve territorial, economic and social integration and to contribute to the cohesion, stability and competitiveness of the region.

Reference:

Katsavouni Sotiria and Miltiadis Seferlis. 2014. Evaluation of functions and values of Attica wetlands in Greece. EKBY, Thessaloniki. 24 pg.

# Introduction

The present work is one of the outputs of the ORIENTGATE Greek pilot project "Effects of climate change on wetlands ecosystem of Attica Region of Greece" (WP5.3, Pilot study 4 of Thematic Centre: Drought, Water and Coasts). It presents the results of the evaluation of Attica wetlands' functions and values.

The document is a synopsis of the Greek version and comprises the following chapters:

*Study areas*

Brief description of the study areas: 1) Asopos estuary and Oropos lagoons, 2) Marathonas reservoir, 3) Sxinias national park, 4) Loutsa wetland, 5) Vravrona wetland, 6) Lake Vouliagmeni, 7) Lake Koumoundourou, 8) Vourkari wetland, and 9) Psatha wetland.

*Functional evaluation methodological approach:*

The WET method for the assessment of wetland functions and values and the HydroGeoMorphological approach (HGM) applied in two wetland sites, are presented.

*Assessment of wetland functions and values:*

The results of the functional assessment of Attiki's wetlands are summarized in tables.

## 1. Study areas

Wetlands in Attica are valuable habitats mainly for migrating birds to rest, winter and reproduce. They also host a great variety of other fauna and flora.

There are about eighty wetlands in Attica and the largest nine ones are the study areas.

## 1.1 Asopos estuary and Oropos lagoon

The first inventory of Greek wetlands (EKBY 1994) included Asopos estuary and Oropos lagoon. Both areas are under severe pressure albeit their great importance. The estuary is 2km west of the lagoon and they are what are left of the once large coastal wetland. Today between the two segments, a dwelling area is expanding. The wetland area decreased from 0.2km$^2$ in 1969 to 0.1km$^2$ in 2010.


**Fig. 1** Asopos estuary and Oropos lagoons (August 2004, Google Earth)

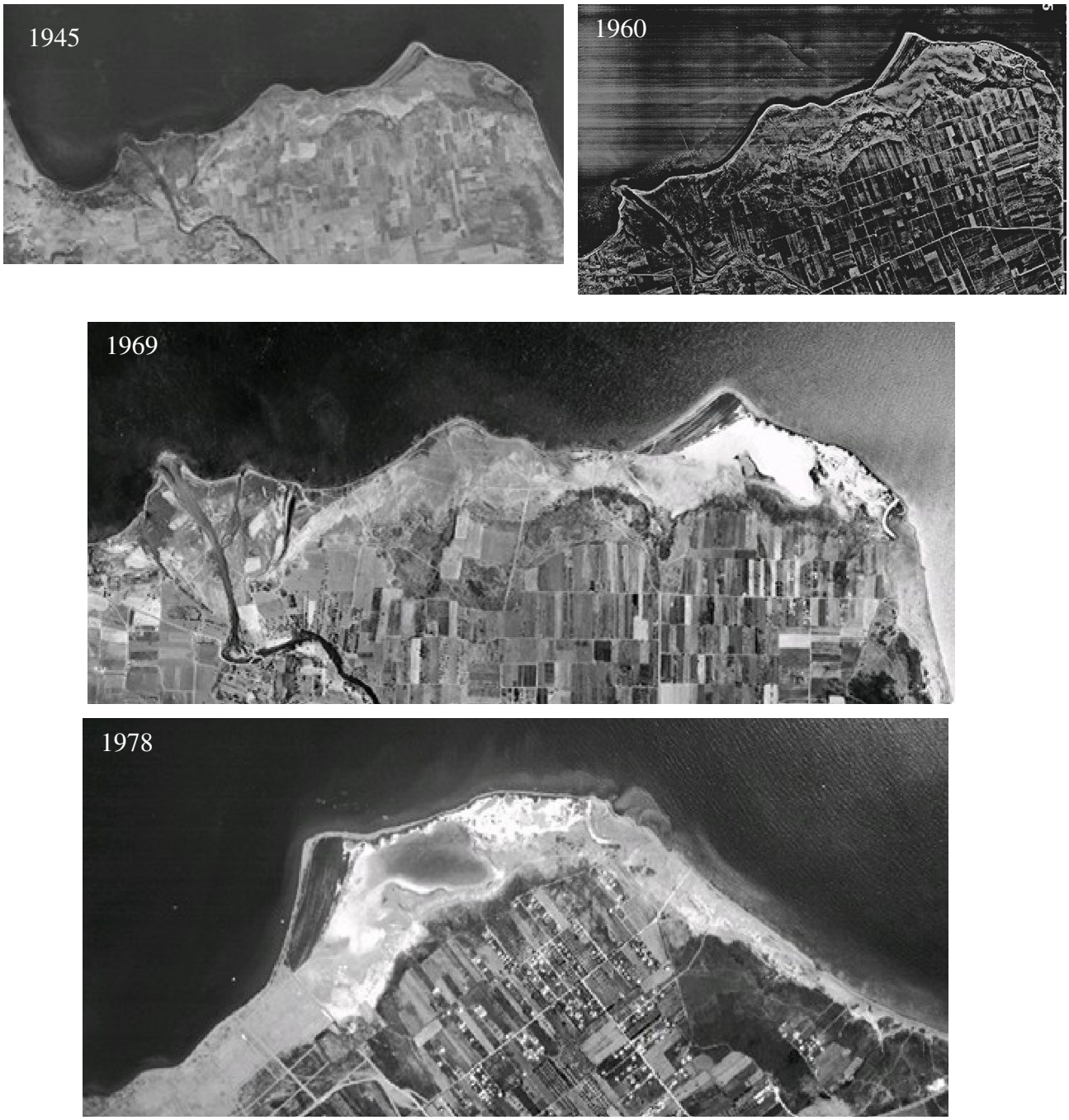


**Fig. 2**. Changes in land use and decrease of the wetland in Asopos-Oropos area

## 1.2 Marathonas reservoir

A dam was built on two streams northeast of Athens in the late '20 to cover the increasing water demand of the expanding city. Marathonas (Fig. 3) reservoir receives water also from the nearby lake Yliki and a 13.4km pipe carries it to Athens.

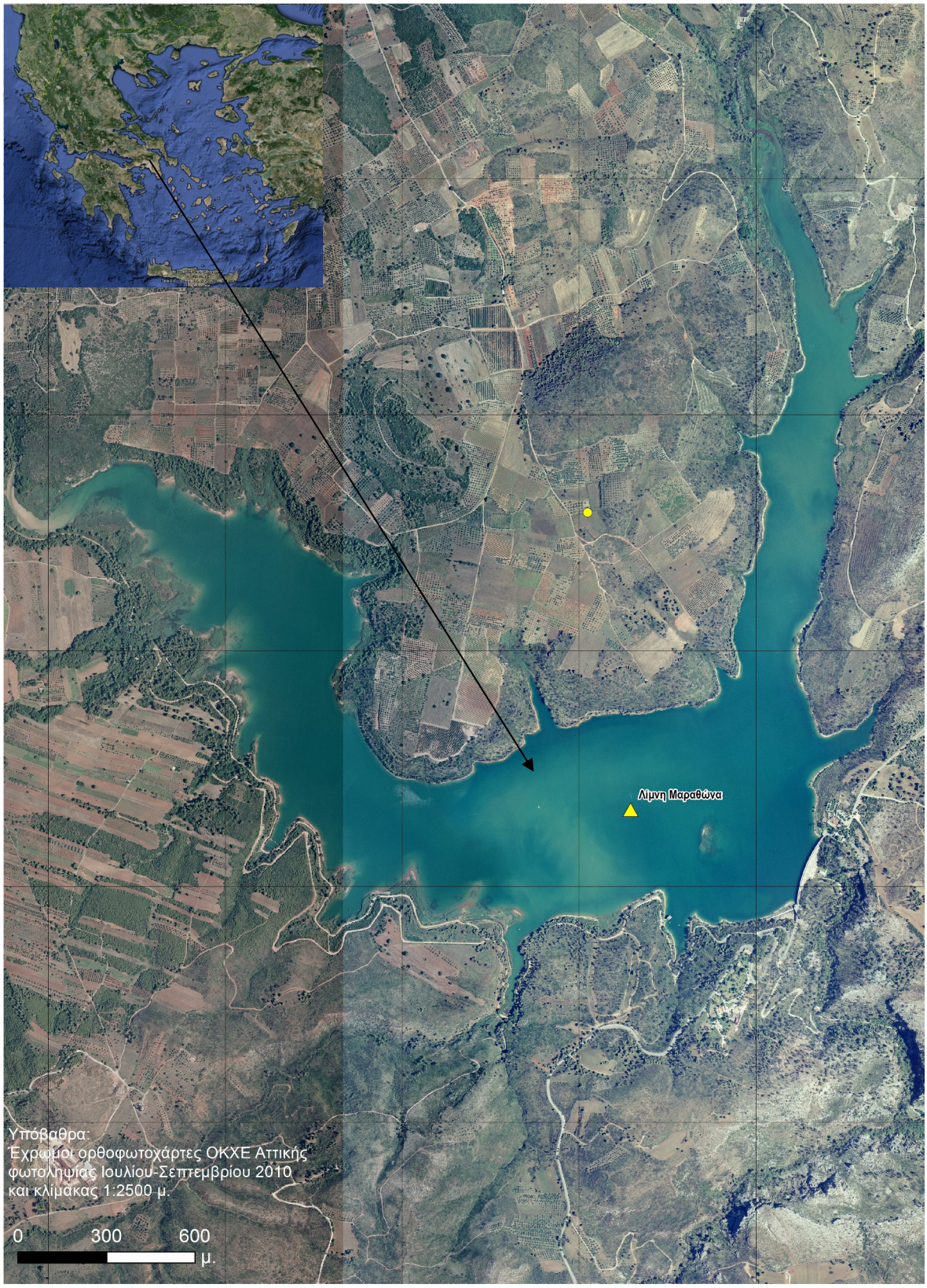


**Fig. 3** Aerial image of Marathonas reservoir (July-September 2010, Greek Cadastral and Mapping Organization)

## 1.3 Shinias - Marathon National Park

The wetland area was designated National Park in 2000 (PD 22.67.2000/Gov. Gazette 395D/3.7.2000) and comprises the coastal wetland, the Makaria Spring, Drakonera Hill and Kinosoura peninsula. The same area belongs to NATURA2000 (GR3000003).

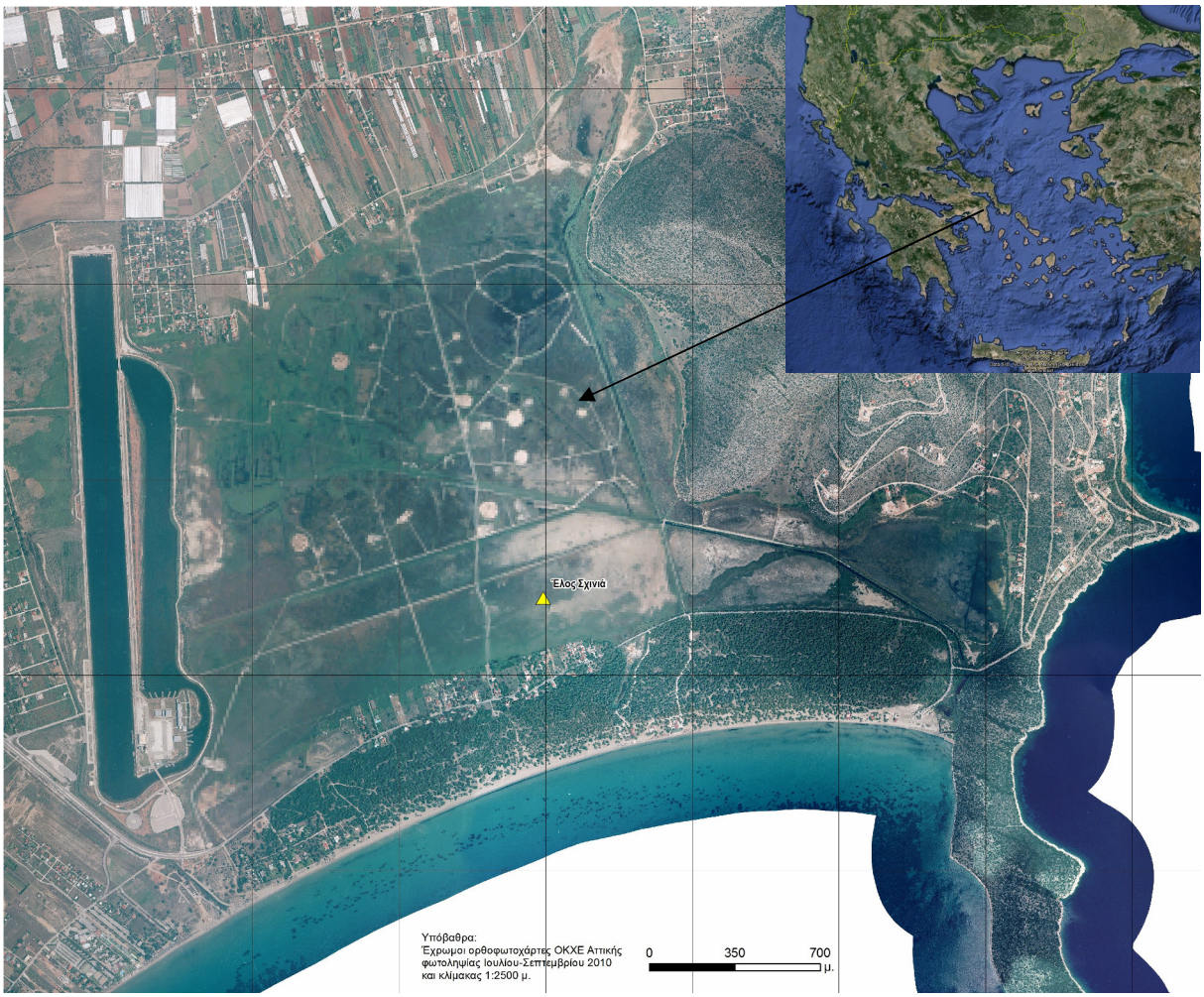


**Fig. 4** Aerial image of the Schinias – Marathon National Park (July-September 2010, Greek Cadastral and Mapping Organization)

The wetland had been under pressure until 2000 by tourism and uncontrolled building in the coastal pine forest. The forest of *Pinus halepensis* and *Pinus pinnea* is one of the few left in Greece and Mediterranean.

Eels, tortoises and the endangered freshwater endemic fish *Pseudophoxinus stymphalicus marathonicus* (Economides 1991) live in Makaria Sping.

About 101 bird species have been recorded in the area (Tzalis et al 2013, Dimaki & Alivizatos pers.) and there are 20 species of Dir. 2009/147/EC Annex I.

## 1.4 Loutsa wetland

Loutsa is a confined coastal shallow wetland with freshwater of about 0.18km$^2$ (2010). The wetland area covered 0.14km$^2$ in 1969. Thirty six bird species have been recorded and three of them are listed in Dir. 2009/147/EC Annex I. The area had been used as a pit for inert litter and additional pressure was coming from tourist traffic.

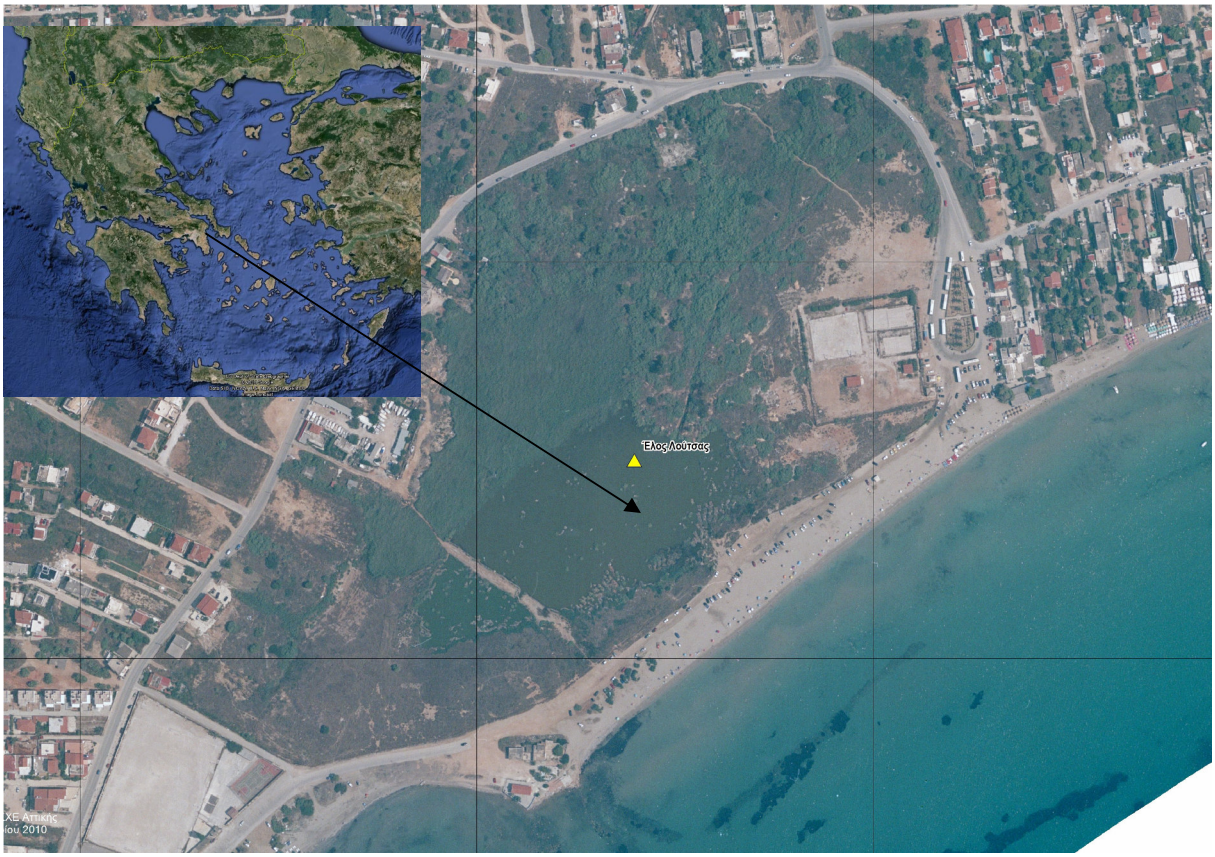


**Fig. 5** Aerial image of Loutsa wetland (July-September 2010, Greek Cadastral and Mapping Organization, GoogleEarth)

## 1.5 Vravrona wetland

The wetland (Fig. 6) is the estuary of Erasinos River and it is listed as SCI GR3000004 "Vravrona – paraktia thalassia zoni". There is a small agricultural area on the west side while on the east front there are reeds and mudflats. Eighty-eight bird species have been recorded and 14 of them are listed in Dir. 2009/147/EC Annex I.


**Fig. 6** Aerial image of Vravrona wetland (July-September 2010, Greek Cadastral and Mapping Organization)

## 1.6 Lake Voulliagmeni

Lake Vouliagmeni (Attica, Greece, Fig. 7) is a lagoon of great scientific interest due to its endemic fauna, widely used for recreational activities. It was formed about 2000 years ago after the collapse of a large cavern near the rocky coast line south of Mount Hymettos. On the lake bottom, there is the mouth of a 3km underground cave. The lake is as an important Monument of Nature and a Natura 2000 SCI site. The lake water springs from 50-100m below surface. The water temperature varies between 22◦C and 29◦C. The level of the Lake's water is half a meter above the sea level making it to move towards the sea, therefore, keeping its waters constantly renewed however it is brackish water (14,5 – 17 psu). Twelve floral and 10 faunal species have been identified and it is one of the less diverse Mediterranean lagoons. The endemic *Paranemonia vouliagmeniensis* was identified in 1987. Three fish species have been identified in the lake namely *Anguilla anguill*a (Linnaeus 1758), the introduced *Poecilia latipinna* (Lesueur 1821) and *Millerigobius macrocephalus* (Kolombatovic 1891). For the last one Lake Vouliagmeni is the first known landlocked population of the species and is the first record of the species in oligohaline conditions.


**Fig. 7** Aerial image of lake Vouliagmeni (July-September 2010, Greek Cadastral and Mapping Organization, GoogleEarth)

## 1.7 Lake Koumoundourou

Lake Koumoundourou is a small lake at West Attiki of about 0.14km$^2$. The lake suffered an extensive decrease from 1969 when it covered about 0.23km$^2$. It is close to restricted army area and inside a heavily industrialized zone (Fig. 8). The decrease was due to the expansion of the nearby motorway.


**Fig. 8** Lake Koumoundorou (July-September 2010, Greek Cadastral and Mapping Organization, GoogleEarth)

It is a brackish shallow lake with mean depth 1.5m and maximum depth 3m and it is fed by underground springs. On the north, side there is weir to maintain water level. In 1974, the lake was designated as an archaeological site (Gov. Gazette 5/B/8-1-1974) and following Law 2742/1999, a 50m perimeter has been designated as "suburban park". In antiquity, two lakes existed in the area and they were connected to Eleusinian mysteries.

According to the Hellenic Ornithological Society (Tzali et. al. 2013) 36 bird species live in the lake 6 of which are listed sin Annex I of Dir 2009/147/EC.

## 1.8 Vourkari wetland

This is a shallow coastal lagoon in a heavily industrialized area (Fig. 9). However 80 bird species have been recorded 19 of which are listed in Annex I of Dir. 2009/147/EC. Several couples of the black-headed gull (*Laurus ridibundus*) which is an endangered species of the Greek Red Data Book winter in the wetland (Legakis & Maragou 2009).


**Fig. 9** Vourkari lagoon at Megara, West Attika (July-September 2010, Greek Cadastral and Mapping Organization, GoogleEarth)

Also 3 amphibians, 6 reptiles and 10 mammals have been identified while 17 fish species are in abundance in the gulf (Margari 2004 unpublished).

## 1.9 Psatha wetland

This is a small coastal wetland of 0.40km$^2$ formed by several small streams with season flow. However, a small wetland t is an important passage for migrating birds in a hilly-forested area. There are no detail records about birds and the most serious threat it is uncontrolled construction.

**Fig. 10** Psatha wetland (July-September 2010, Greek Cadastral and Mapping Organization, GoogleEarth)

# 2. Functional evaluation methodological approach

## 2.1 Wetland Evaluation Technique (WET)

Evaluation of wetland functions was conducted following a combination of the Wetland Evaluation Technique, WET, (Adamus et al 1978) and the hydrogeomorphological classification (Brinson 1993, Brinson 1993b, Maltby 2009). Wetland functions are the physical, chemical, and biological characteristics of a wetland. Wetland values are those characteristics that are beneficial to society.

WET evaluates functions and values by characterizing the wetland in terms of certain factors. These are simple or integrated variables that are believed to correlate with the physical, chemical and biological characteristics of the wetland and its surroundings. Responses to questions concerning the factors are analyzed in a series of interpretation keys that reflect the relationship between factors and wetland functions or values as defined in the technical literature. Interpretation keys assign a qualitative rating of HIGH, MODERATE or LOW to each function and value in terms of social significance, effectiveness and opportunity.

WET evaluates the following functions and values: water storage, floodflow alteration, ground water recharge, sediment/toxicant retention, nutrient removal/transformation, wildlife diversity/abundance, aquatic diversity/abundance, coastline stabilization.

The hydrogeomorphic classification is based on three fundamental factors that influence how wetlands function, including geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform of a wetland, its geologic evolution, and its topographic position in the landscape. For example, a wetland may occur in a depressional landform or a valley landform and may occur at the top, middle, or bottom of a watershed. Water source refers to the location of water just prior to entry into the wetland. All water on the land originates as precipitation, but in many cases the water will follow a circuitous path prior to entry into a wetland. For example, water may enter the wetland directly as precipitation, follow a less direct path over the surface of the ground as overland flow or overbank flow, follow a subsurface path as interflow, throughflow, or baseflow, or any combination of these. Hydrodynamics refers to the energy level of moving water, and the direction that surface and near-surface water moves in the wetland. For example, the level of energy of an isolated wetland is generally lower than a wetland on a river floodplain, and the movement of water in a riverine wetland is generally unidirectional and downstream. In the hydrogeomorphic classification, each of these factors is treated separately; however, considerable interaction is recognized given the multivariate nature of ecosystems.

**Table 1.** Factors that correlate with the physical, chemical and biological characteristics of a wetland and reflect the wetland functions/values

| Predictors | Functions/values | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Water storage** | **Food web support** | **Nutrient removal/transformation** | **Sediment/toxicant retention** | **Floodflow alteration** | **Groundwater recharge** | **Shoreline stabilization** |
| Wetland area percentage in the catchment | | | ✓ | | | | |
| wetland location | ✓ | | | ✓ | ✓ | | |
| Water chemistry | | ✓ | ✓ | | | | |
| Hydroperiod | | ✓ | ✓ | | | | |
| Bottom gradient / water velocity | | | ✓ | ✓ | | | |
| Water inlet | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| Water velocity | | ✓ | ✓ | | ✓ | | |
| Water depth | ✓ | ✓ | | ✓ | | | |
| Vegetation percentage | | | ✓ | | ✓ | | ✓ |
| Substrate type | ✓ | | ✓ | ✓ | | ✓ | |
| Wetland type | | | | ✓ | ✓ | ✓ | ✓ |
| Vegetation type | | ✓ | ✓ | ✓ | | | |
| Water sources | ✓ | | | | | ✓ | |
| Catchment | ✓ | | | | | | |
| Habitat diversity | | ✓ | | | | | |

(Source: Adamus et al. 1987, Marble 1992)

## 2.2 Hydrogeomorphic units

**Asopos – Oropos lagoon**

Four hydrogeomorphic units (HGMU) had been identified in the wetland are of Asopos and Oropos.

| HGMU | Length (km) / area (km²) | % length of main channel / % area of watershed |
|---|---|---|
| A | ~ 1 km | 1,7 % |
| $B_{1-4}$ | 0,573 km² | 0,08 % |
| C | 0,26 km² | 0,04 % |
| D | 0, 26 km² | 0,04 % |

**Sxinias National Park**

Four hydrogeomorphic units (HGMU) had been identified in Sxinias National Park .

| HGMU | Length (km) / area (km²) |
|---|---|
| A | 0,74 (km²) |
| B | 1,21 (km²) |
| C | 4,40 (km²) |
| D | 0,92 (km²) |

The rest of the wetlands comprise only one HGMU and for this reason, they are not referred here.

## 3. Assessment of wetland functions and values

The results of the functional assessment of Attiki's wetlands are summarized in the following tables. For each wetland two tables have been drawn, one presenting those functions performed in the corresponding wetland and the rate of performance; and the second presenting the values and services arising from these functions.

**Table 2.** Functions of Asopos and Oropos wetlands

| HGMU | Wetland function | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water storage | Food web support | Avifauna support | Nutrient removal/transformation | Sediment/toxicant retention | Floodflow alteration | Groundwater recharge | Coastline stabilization |
| | Function rate | | | | | | | |
| A | Low | Low | High | Low | High | Low | Moderate | High |
| $B_{1-4}$ | Low | Low | Moderate | Moderate | Moderate | Moderate | Low | High |
| C | Low | Low | High | Low | Moderate | Moderate | Low | High |
| D | Zero | Low | Moderate | Low | Moderate | Moderate | Low | High |

**Table 3.** Values of Asopos and Oropos wetlands

| HGMU | Wetland value | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biodiversity | Irrigation water | Fishing | Stock raising | Hunting | Scientific | Education | Recreation | Culture | Improving water quality | Floodflow alteration | Protection against erosion | Topoclimate |
| | Value rate | | | | | | | | | | | | |
| Asopos estuary (HGMU A,$B_{1-4}$) | Moderate | Zero | Zero | Zero | Moderate | High | High | Moderate | Zero | Low | Moderate | Moderate | High |
| Oropos lagoon (HGMU C, D) | Moderate | Zero | Zero | Zero | Moderate | High | High | Moderate | Zero | Low | Moderate | Moderate | High |

**Table 4.** Wetland functions of Marathon lake

| Wetland function | Function rate | | | | |
|---|---|---|---|---|---|
| | High | Moderate | Low | Zero | Unidentified |
| Water storage | √ | | | | |
| Food web support (fauna other than birds) | √ | | | | |
| Food web support: avifauna | √ | | | | |
| Nutrient removal/transformation | √ | | | | |
| Sediment/toxicant retention | √ | | | | |
| Floodflow alteration | √ | | | | |
| Groundwater recharge | | | | | √ |
| Shoreline stabilization | | | | √ | |

**Table 5.** Wetland values of Marathon lake

| Wetland value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | √ | | | |
| Irrigation water | √ | | | |
| Fishing | | √ | | |
| Stock raising | | | √ | |
| Hunting | | √ | | |
| Scientific | √ | | | |
| Education | √ | | | |
| Recreation | √ | | | |
| Culture | | √ | | |
| Improving water quality | √ | | | |
| Floodflow alteration | √ | | | |
| Protection against erosion | | | | √ |
| Topoclimate | √ | | | |

**Table 6.** Wetland functions of Sxinias National Park

| HGMU | Wetland function | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water storage | Foodweb support | Avifauna support | Nutrient removal/transformation | Sediment/toxicant retention | Floodflow alteration | Groundwater recharge | Shoreline stabilization |
| | Function rate | | | | | | | |
| A | Low | High | High | High | High | Moderate | Unidentified | Zero |
| B | Low | High | High | High | High | Moderate | Unidentified | High |
| C | Moderate | High | High | High | High | Moderate | Unidentified | Zero |
| D | High | High | High | Zero | Zero | Low | Unidentified | Zero |

**Table 7.** Wetland values of Sxinias National Park

| HGMU | Wetland value | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Biodiversity | Irrigation water | Fishing | Stock raising | Hunting | Scientific | Education | Recreation | Culture | Improv. water quality | Floodflow alteration | Protect. against erosion | Topoclimate |
| | Value rate | | | | | | | | | | | | |
| A, C | High | Zero | Zero | Zero | High | High | High | High | Zero | High | Moderate | Zero | High |
| B | High | Zero | Zero | Zero | High | High | High | High | Zero | High | High | High | High |
| D | High | Zero | Zero | Zero | High | High | High | High | Zero | Zero | Low | Zero | High |

**Table 8.** Functions of Loutsa wetland

| Wetland function | Function rate | | | | |
|---|---|---|---|---|---|
| | High | Moderate | Low | Zero | Unidentified |
| Water storage | | | √ | | |
| Food web support (fauna other than birds) | | | √ | | |
| Food web support: avifauna | | √ | | | |
| Nutrient removal/transformation | | √ | | | |
| Sediment/toxicant retention | | √ | | | |
| Floodflow alteration | | √ | | | |
| Groundwater recharge | | | | | √ |
| Shoreline stabilization | | | √ | | |

**Table 9.** Values of Loutsa wetland

| Wetland value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | | √ | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | | √ |
| Hunting | | √ | | |
| Scientific | √ | | | |
| Education | √ | | | |
| Recreation | | √ | | |
| Culture | | | | √ |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | | | √ | |
| Topoclimate | √ | | | |

**Table 10.** Functions of Vravrona wetland

| Wetland function | Function rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Unidentified |
| Water storage | | | √ | |
| Food web support (fauna other than birds) | | √ | | |
| Food web support: avifauna | √ | | | |
| Nutrient removal/transformation | | √ | | |
| Sediment/toxicant retention | | √ | | |
| Floodflow alteration | | √ | | |
| Groundwater recharge | | | | √ |
| Shoreline stabilization | | √ | | |

**Table 11.** Values of Vravrona wetland

| Wetland Value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | √ | | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | √ | |
| Hunting | √ | | | |
| Scientific | √ | | | |
| Education | | √ | | |
| Recreation | | √ | | |
| Culture | √ | | | |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | | √ | | |
| Topoclimate | √ | | | |

**Table 12.** Functions of Lake Vouliagmeni

| Wetland function | Function rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Water storage | | √ | | |
| Food web support (fauna other than birds) | | | √ | |
| Food web support: avifauna | | | √ | |
| Nutrient removal/transformation | | | √ | |
| Sediment/toxicant retention | | √ | | |
| Floodflow alteration | | | √ | |
| Groundwater recharge | | | | √ |
| Shoreline stabilization | | | | √ |

**Table 13.** Values of Lake Vouliagmeni

| Wetland Value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | | √ | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | | √ |
| Hunting | | | √ | |
| Scientific | √ | | | |
| Education | √ | | | |
| Recreation | √ | | | |
| Culture | | | | √ |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | | | | √ |
| Topoclimate | √ | | | |

**Table 14.** Functions of Lake Koumoundourou

| Wetland function | Function rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Water storage | | √ | | |
| Food web support (fauna other than birds) | | | √ | |
| Food web support: avifauna | | √ | | |
| Nutrient removal/transformation | | √ | | |
| Sediment/toxicant retention | | √ | | |
| Floodflow alteration | | √ | | |
| Groundwater recharge | | | | √ |
| Shoreline stabilization | | | | √ |

**Table15.** Values of Lake Koumoundourou

| Wetland Value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | | √ | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | | √ |
| Hunting | | √ | | |
| Scientific | √ | | | |
| Education | √ | | | |
| Recreation | | | √ | |
| Culture | √ | | | |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | | | | √ |
| Topoclimate | √ | | | |

**Table 16.** Functions of Vourkari wetland

| Wetland Function | Function rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Water storage | | | √ | |
| Food web support (fauna other than birds) | | | √ | |
| Food web support: avifauna | | √ | | |
| Nutrient removal/transformation | | √ | | |
| Sediment/toxicant retention | | √ | | |
| Floodflow alteration | | √ | | |
| Groundwater recharge | | | | √ |
| Shoreline stabilization | √ | | | |

**Table 17.** Values of Vourkari wetland

| Wetland Value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | | √ | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | √ | |
| Hunting | | √ | | |
| Scientific | √ | | | |
| Education | | √ | | |
| Recreation | | | √ | |
| Culture | | √ | | |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | √ | | | |
| Topoclimate | √ | | | |

**Table 18.** Functions of Psatha wetland

| Wetland function | Function rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Water storage | | | √ | |
| Food web support (fauna other than birds) | | | √ | |
| Food web support: avifauna | | √ | | |
| Nutrient removal/transformation | | √ | | |
| Sediment/toxicant retention | √ | | | |
| Floodflow alteration | | √ | | |
| Groundwater recharge | | | | √ |
| Shoreline stabilization | | √ | | |

**Table 19.** Values of Psatha wetland

| Wetland Value | Value rate | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Zero |
| Biodiversity | | √ | | |
| Irrigation water | | | | √ |
| Fishing | | | | √ |
| Stock raising | | | √ | |
| Hunting | | | √ | |
| Scientific | √ | | | |
| Education | | √ | | |
| Recreation | | √ | | |
| Culture | | | | √ |
| Improving water quality | | √ | | |
| Floodflow alteration | | √ | | |
| Protection against erosion | | √ | | |
| Topoclimate | √ | | | |